Satellite SAR Exploitation and Imaging and Measurement of Oceanic Phenomena

Hans C. Graber
CSTARS - University of Miami
11811 SW 168th Street, Miami, FL 33177-, USA
phone: (305) 421-4952, fax: (305) 252-4407, email: hgraber@rsmas.miami.edu

William M. Drennan
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
phone: (305) 421-4798, fax: (305) 421-4701, email: wdrennan@rsmas.miami.edu

Roland Romeiser
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
phone: (305) 421-4645, fax: (305) 421-4701, email: rromeiser@miami.edu

Neil J. Williams
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
phone: (305) 421-4656, fax: (305) 421-4701, email: nwilliams@rsmas.miami.edu

Michael J. Caruso
CSTARS - University of Miami
11811 SW 168th Street, Miami, FL 33177-, USA
phone: (305) 421-4973, fax: (305) 252-4407, email: mcaruso@rsmas.miami.edu

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LONG-TERM GOALS

This proposal consists of six individual self-contained projects. A common component of all tasks is the exploitation of satellite imagery. The six projects are listed as the following tasks:

Task 1: Air-Sea Interactions in Typhoon Conditions
Task 2: Satellite Observations of Surface Signatures and Properties of Internal Waves in Straits

Task 3: Satellite Observations, Surface Signature and Properties of Nonlinear Internal Waves

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Task 4: Satellite Observations of Surface Signatures in the Philippine Sea
Task 5: Satellite Observations of Oceanographic Processes for Quantifying, Predicting, and Exploiting Uncertainty (QPE)
Task 6: Exploitation of Commercial Satellite Radars

The long term goal of this project is to employ satellite SAR imagery to the quantitative analysis of typhoons, internal waves, ocean surface features, sea state prediction and coastal dynamics. To achieve this, a variety of satellite SAR sensors with different imaging frequencies, multi-polarizations and different beam modes are used to determine which combination of the above capabilities could provide the best solution.

OBJECTIVES

For simplicity we provide only a primary objective of each task.

a) Task 1: To determine the characteristics of typhoons with satellite SAR imagery.
b) Task 2: To complement the acquisition and analysis of conventional radar intensity images and other data by direct high-resolution imaging of surface current fields from space by along-track InSAR.
c) Task 3: To measure surface signatures and Bragg modulations during the passage of soliton packets.
d) Task 4: To improve the characterizations of the Philippine Archipelago Straits dynamics we propose to acquire satellite data, in particular synthetic aperture radar (SAR) imagery of features and processes present in these straits.
e) Task 5: To determine the structure, the seasonal and annual variability of the cold dome over the outer continental shelf northeast of Taiwan and the position and variability of the Kuroshio Current, in particular excursions onto the continental shelf.
f) Task 6: To explore innovative uses for commercial radar applications.

APPROACH

Satellite based Synthetic Aperture Radar (SAR) can operate day and night and in all weather condition. As a matter of fact, radar penetrates clouds but ultimately restricts the use of optical sensors such as MODIS to image typhoons. Furthermore, radars are truly sensing the surface and therefore observe the impact of the atmosphere on the ocean surface. SAR can provide large spatial coverage up to 500 km wide swaths using the ScanSAR mode but at lower resolution (~50 to 100 m) for the directional wave spectra, surface wind vectors, and surface roughness.

The high-resolution of SAR wind retrievals make these data suitable for understanding tropical cyclone morphology. In particular, the wind structure of eye wall replacement and the formation of thunderstorms and tornados in hurricanes can be imaged from all-weather SARs. Examples of high-resolution wind speed image of Hurricane Katrina from the Envisat SAR shows the detail with which SARs can measure, in all weather, wind speed variability in a hurricane eye. Such high-resolution wind fields have been routinely produced by CSTARS for the last three years as a HurricaneWatch

demonstration project with CSA and ESA. Such wind fields have also been provided to the National Hurricane Center for evaluation. Figure 1 shows the best track from the Typhoon Warning Center and a satellite SAR wind field of Typhoon Longwang after its passage over Taiwan.

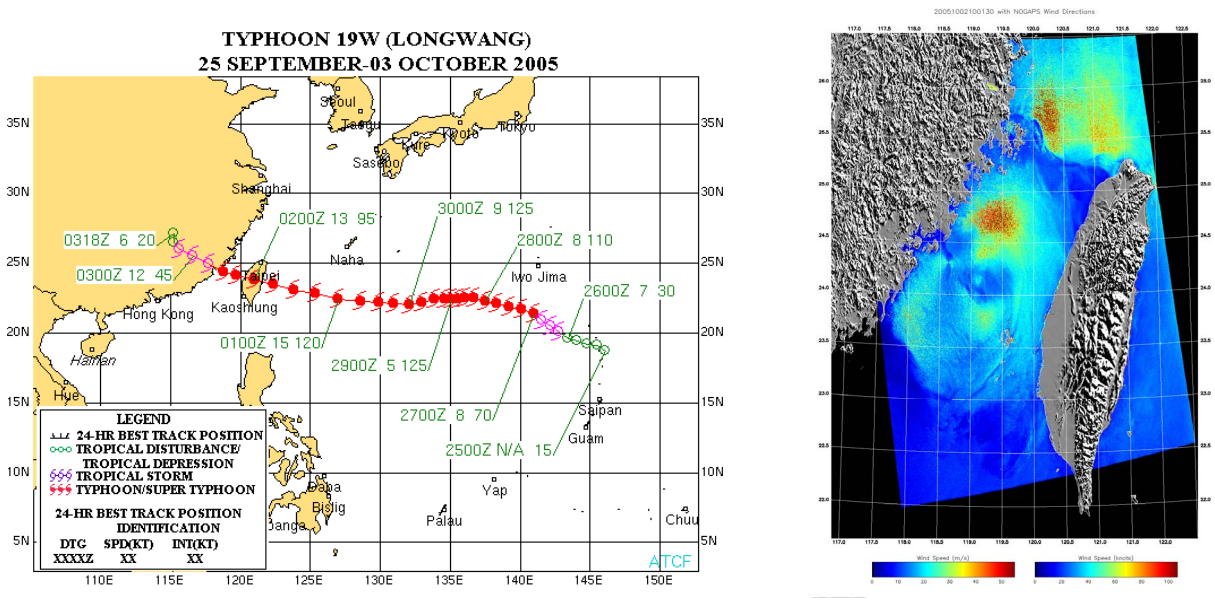

Figure 1: Left: Best track from the Joint Typhoon Warning Center (JTWC) for Typhoon Longwang impacting the Southeast Asia Sea region. Right: Hurricane wind field derived from RadarSat-1 ScanSAR images using the JHU/APL ANSWRS system running at CSTARS.

WORK COMPLETED

1) SAR data collection during the last PhilEx experimental phase and in support of glider and ship operations completed.
2) Extensive satellite collections of EO and SAR sensors during the QPE experiment completed.
3) Tiling methodology developed to minimize bandwidth problems when images are viewed with GoogleEarth.

RESULTS

None.

IMPACT/APPLICATIONS

Sapce- based radar emote sensing will have a significant impact on

TRANSITIONS

None. Project just started.

RELATED PROJECTS

None. Project just started.